



US009302551B2

(12) **United States Patent**
Kiwaki

(10) **Patent No.:** **US 9,302,551 B2**
(45) **Date of Patent:** **Apr. 5, 2016**

(54) **PNEUMATIC TIRE WITH TREAD HAVING V-SHAPED GROOVE**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(75) Inventor: **Yukihiro Kiwaki**, Tokyo (JP)

5,435,364 A * 7/1995 Hasegawa B60C 11/0302
152/209.18

(73) Assignee: **BRIDGESTONE CORPORATION**,
Tokyo (JP)

6,478,062 B1 * 11/2002 Schomburg 152/209.18

(Continued)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 999 days.

FOREIGN PATENT DOCUMENTS

EP 1506884 A1 * 2/2005
JP 06-344726 A * 12/1994

(Continued)

OTHER PUBLICATIONS

(21) Appl. No.: **12/531,197**

(22) PCT Filed: **Mar. 10, 2008**

Machine translation for Japan 09-002024 (no date).*

(86) PCT No.: **PCT/JP2008/054320**

(Continued)

§ 371 (c)(1),

(2), (4) Date: **Sep. 14, 2009**

Primary Examiner — Steven D Maki

(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(87) PCT Pub. No.: **WO2008/126551**

PCT Pub. Date: **Oct. 23, 2008**

(57) **ABSTRACT**

At least one of land portion sections **14**, **15**, **16** that are formed in a tread surface portion **10a** is constituted by a first land portion **17** and a second land portion **18** being alternately and consecutively arranged along the tire circumference direction R, and a first top surface portion **17a** and a first inclined surface portion **17b** whose recess amount inward in a radial direction of the tire gradually increases in accordance with heading from the first top surface portion **17a** toward the outer side in a width direction of the tire H are provided in a first land portion **17**, and a second top surface portion **18a** and a second inclined surface portion **18b** whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the second top surface portion **18a** toward the inner side in the width direction of the tire H are provided in a second land portion **18**, and by the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlapping in the circumferential direction of the tire R, a V-shaped groove that has the first inclined surface portion **17b** and the second inclined surface portion **18b** as portions of side walls is formed. According to the present invention, it is possible to prevent a decline in steering stability and to improve drainage performance.

(65) **Prior Publication Data**

US 2010/0096054 A1 Apr. 22, 2010

(30) **Foreign Application Priority Data**

Mar. 14, 2007 (JP) 2007-064634

(51) **Int. Cl.**

B60C 11/03 (2006.01)

B60C 11/13 (2006.01)

(52) **U.S. Cl.**

CPC **B60C 11/13** (2013.01); **B60C 11/0304**
(2013.04); **B60C 11/1384** (2013.04); **B60C**
11/1392 (2013.04)

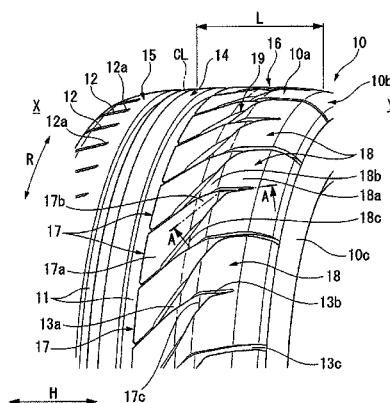
(58) **Field of Classification Search**

CPC B60C 11/0304; B60C 11/1384; B60C
11/1392; B60C 11/13

USPC 152/209.8, 209.15, 209.21; D12/518,
D12/519

See application file for complete search history.

6 Claims, 2 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

D559,168 S * 1/2008 Murata D12/519
D571,281 S * 6/2008 Murata et al. D12/519
D640,182 S * 6/2011 Kiwaki D12/518
2001/0017177 A1 8/2001 Himuro
2006/0108040 A1 5/2006 Miyazaki
2010/0252157 A1 * 10/2010 Ito 152/209.8
2013/0048173 A1 * 2/2013 Kiwaki 152/209.18

FOREIGN PATENT DOCUMENTS

JP 09-002024 A * 1/1997
JP 2001-225610 A 8/2001

JP 2003-170705 A 6/2003
JP 2003-191715 A 7/2003
JP 2003-326918 A 11/2003
JP 2004-142698 A 5/2004
JP 2007-055479 A 3/2007

OTHER PUBLICATIONS

Machine translation for Europe 1,506,884 (no date).
Machine translation for Japan 06-344726 (no date).
Extended European Search Report dated Jan. 3, 2011, corresponding to Application No. PCT/JP2008054320.
International Search Report for PCT/JP2008/054320 dated Jun. 10, 2008.

* cited by examiner

FIG. 1

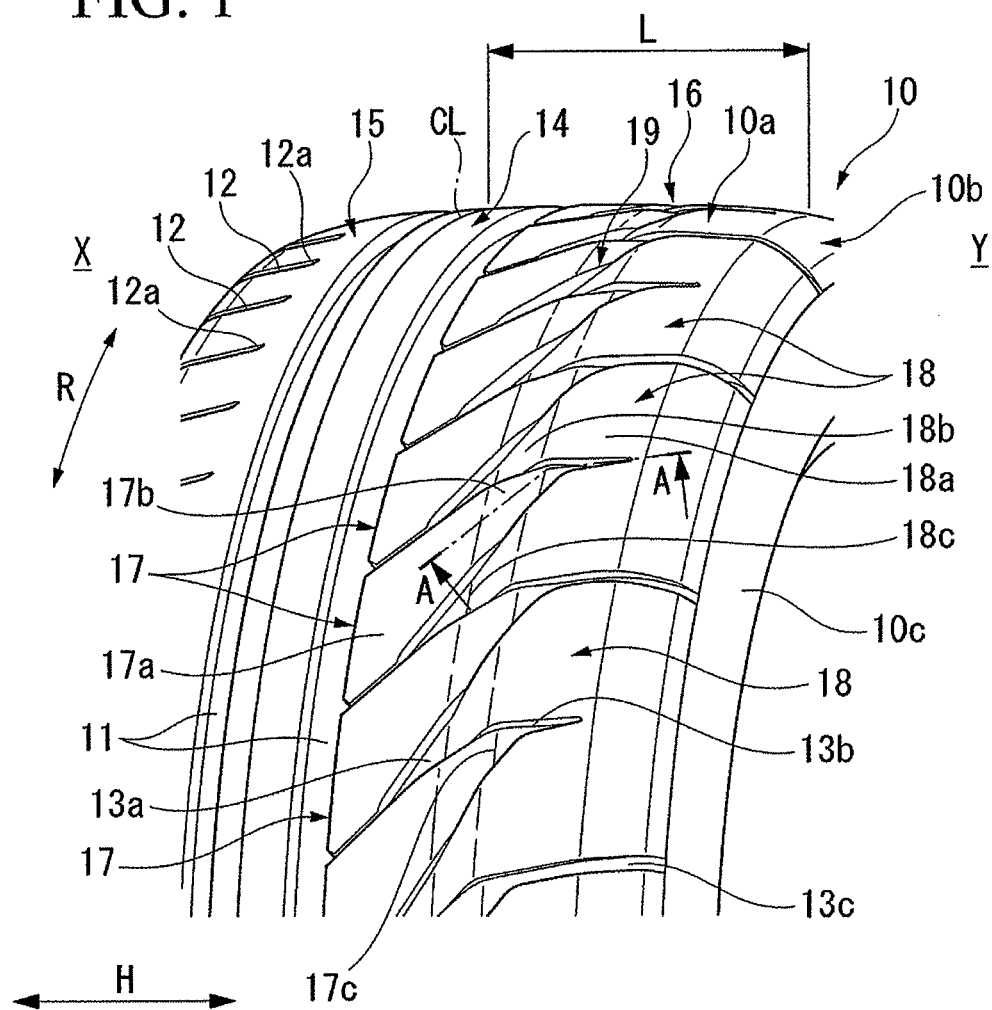
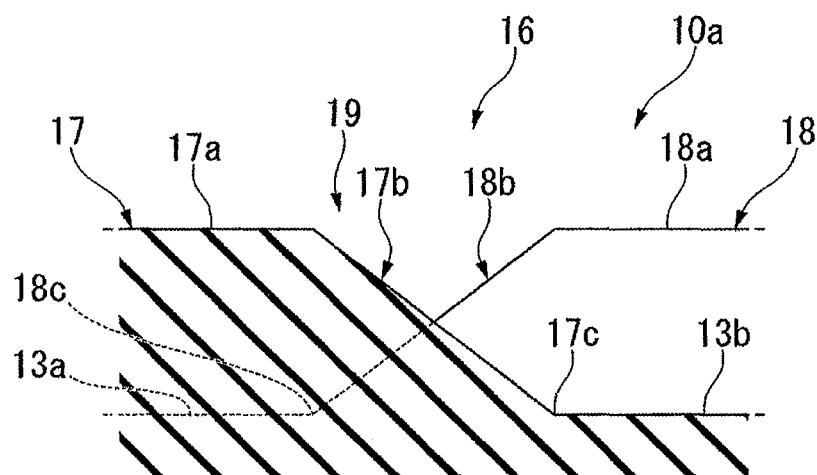


FIG. 2



1

PNEUMATIC TIRE WITH TREAD HAVING V-SHAPED GROOVE

TECHNICAL FIELD

The present invention relates to a pneumatic tire.

Priority is claimed on Japanese Patent Application No. 2007-064634, filed Mar. 14, 2007, the content of which is incorporated herein by reference.

BACKGROUND ART

As this type of pneumatic tire, a constitution such as shown for example in Patent Document 1 is conventionally known in which a plurality of circumferential direction main grooves that extend along a circumferential direction of the tire and a plurality of land portion sections that extend along the circumferential direction of the tire are formed on a tread surface portion.

By these circumferential direction main grooves, a pneumatic tire is made to easily discharge water between a wet road surface and a dry contact surface to the outside, that is, have good drainage performance.

[Patent Document 1] Japanese Unexamined Patent Application Publication No. 2003-170705

However, in the aforementioned conventional pneumatic tire, when a large compressive force acts on a ground contact area of the tire toward the inside in a radial direction of the tire while traveling on a dry road surface, the land portion that continues to the circumferential direction main groove is pushed in toward the inside in the radial direction of the tire, the belt layer that is inward of this portion locally buckles, and so the contact pressure that acts on this ground contact area of the tire becomes uneven, whereby the steering stability may be decreased.

The present invention has been achieved in view of the above circumstances, and has as its object to provide a pneumatic tire that is capable of preventing decrease of the steering stability and can improve drainage performance.

DISCLOSURE OF THE INVENTION

In order to solve the aforementioned issues and achieve such an object, the pneumatic tire of the present invention is a pneumatic tire in which a plurality of circumferential direction grooves that extend along the circumferential direction of the tire and a plurality of land portion sections that extend along the circumferential direction of the tire are formed in a tread surface portion, characterized by at least one of the land portion sections that are arranged at positions separated from an equatorial portion of the tire among the plurality of land portion sections being constituted by a first land portion and a second land portion that are alternately and consecutively arranged in the circumferential direction of the tire, and a first top surface portion that is positioned on the inner side of a width direction of the tire and a first inclined surface portion whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the first top surface portion toward the outer side in the width direction of the tire being provided in the first land portion, a second top surface portion that is positioned on the outer side of the width direction of the tire and a second inclined surface portion whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the second top surface portion toward the inner side in the width direction of the tire being provided in the second land portion, and by the first inclined surface portion and the second

2

inclined surface portion mutually overlapping in the circumferential direction of the tire, one of the plurality of circumferential direction main grooves being formed in this land portion section as a V-shaped groove that has the first inclined surface portion and the second inclined surface portion as portions of side walls.

In this invention, since a V-shaped groove that has the first inclined surface portion and the second inclined surface portion as portions of side walls is formed in at least one of the land portion sections that are arranged at positions separated from the equatorial portion of the tire among the plurality of land portion sections that are formed in the tread surface portion, it becomes possible to absorb a compressive force heading inward in the radial direction of the tire that acts on the first top surface portion of the first land portion and the second top surface portion of the second land portion by the first and second inclined surface portions. Accordingly, during travel on a dry road surface, even if a large compressive force heading inward in the radial direction of the tire acts on the first top surface portion and the second top surface portion, it is possible to suppress the occurrence of buckling, and it is possible to prevent a decline in steering stability.

Also, since portions of the side walls that the V-shaped circumferential direction main groove include the first and second inclined surface portions, by causing water between a wet road surface and the first and second top surface portions to pass over these first and second inclined surface portions, it is possible to make it smoothly flow into this V-shaped groove main groove without resistance, and it is possible to improve the drainage performance by preventing the water in the V-shaped groove from entering a turbulent state when flowing in.

Here, the V-shaped groove may be arranged in the tread surface portion at a position that is separated in the width direction of the tire from the equatorial portion of the tire by $\frac{1}{2}$ of the distance in the width direction of the tire between the equatorial portion of the tire and the end portion in the width direction of the tire.

In this case, since the V-shaped groove is formed in the tread surface portion at a position that is separated in the width direction of the tire from the equatorial portion of the tire by $\frac{1}{2}$ of the distance in the width direction of the tire between the equatorial portion of the tire and the end portion in the width direction of the tire where buckling most easily occurs, it is possible to reliably suppress the occurrence of this buckling.

Also, the depths at the respective inward ends in the radial direction of the tire of the first inclined surface portion and the second inclined surface portion may be mutually equivalent, and the first inclined surface portion and the second inclined surface portion may mutually overlap in the circumferential direction of the tire at a depth position of between 30% and 80% of the depth at their respective inward ends in the radial direction of the tire.

In this case, the aforementioned operation effect comes to be reliably exhibited.

That is, when the first inclined surface portion and the second inclined surface portion mutually overlap in the circumferential direction of the tire at a depth position that is less than 30% of the depth at their respective inward ends in the radial direction of the tire, the internal volume of this V-shaped groove is insufficient, leading to the drainage performance being insufficient, also, when the first inclined surface portion and the second inclined surface portion mutually overlap in the circumferential direction of the tire at a depth position that is greater than 80% of the depth at their respec-

3

tive inward ends in the radial direction of the tire, there is a risk of preventing the occurrence of buckling becoming difficult.

Moreover, the size of the first land portion in the circumferential direction of the tire may gradually become smaller in accordance with heading toward the outer side in the width direction of the tire, and the size of the second land portion in the circumferential direction of the tire may gradually become smaller in accordance with heading toward the inner side in the width direction of the tire.

In this case, since the size of the first land portion in the circumferential direction of the tire gradually becomes smaller in accordance with heading toward the outer side in the width direction of the tire, and the size of the second land portion in the circumferential direction of the tire gradually becomes smaller in accordance with heading toward the inner side in the width direction of the tire, it becomes possible to additionally facilitate flowing of water between the wet road surface and the first and second top surface portions into the V-shaped groove, and in addition to being able to reliably increase the drainage performance, it becomes possible to prevent the rigidity of the first top surface portion and the second top surface portion from decreasing by forming the V-shaped groove, and it is possible to prevent a reduction in steering stability and quietness when traveling over a dry road surface.

Effect of the Invention

According to this invention, along with being able to prevent a reduction in steering stability, it is possible to improve the drainage performance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 A perspective view that shows a portion of the pneumatic tire in the embodiment in accordance with the present invention.

FIG. 2 A cross-sectional view along line A-A of the pneumatic tire shown in FIG. 1.

DESCRIPTION OF REFERENCE NUMERALS

10 pneumatic tire; **10a** tread surface portion; **11, 19** circumferential direction main groove; **14** center land portion section (land portion section); **15** inner side shoulder land portion section (land portion section); **16** outer side shoulder land portion section (land portion section); **17** first land portion; **17a** first top surface portion; **17b** first inclined surface portion; **17c** inward end in the radial direction of the tire of the first inclined surface portion; **18** second land portion; **18a** second top surface portion; **18b** second inclined surface portion; **18c** inward end in the radial direction of the tire of the second inclined surface portion; **19** V-shaped circumferential direction main groove (V-shaped groove); CL equatorial portion of the tire; H width direction of the tire; L distance; R circumferential direction of the tire

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinbelow, one embodiment of the pneumatic tire in accordance with the present invention shall be described with reference to FIG. 1 and FIG. 2. In a tread surface portion **10a** of this pneumatic tire **10** are formed a plurality of circumferential direction main grooves **11** and **19** that extend along a circumferential direction of the tire R and a plurality of land

4

portion sections **14, 15**, and **16** that extend along a circumferential direction of the tire R. Note that the plurality of circumferential direction main grooves **11** and **19** are formed apart in the tread surface portion **10a** with a mutual interval in a width direction of the tire H.

Also, this pneumatic tire **10** is provided with a left-right pair of bead portions, a tread portion **10b** that is disposed to the outside in a radial direction of the tire of the bead portions and has a tread surface portion **10a**, a left-right pair of sidewall portions **10c** that couple both end portions of this tread portion **10b** in the width direction of the tire and the outer ends of the bead portions in the radial direction of the tire. A carcass layer is provided that continuously extends across each of the inner portions of the bead portions, the sidewall portions **10c** and the tread portion **10c**. Also, an indicator not illustrated is provided on the pneumatic tire **10** to show the direction of mounting on a vehicle.

Here, in the illustrated embodiment, three of the circumferential direction main grooves **11** and **19** are formed on the tread surface portion **10a**, and two of these are respectively formed at mutually opposite positions sandwiching an equatorial portion of the tire CL in the width direction of the tire H, in the central portion of the tread surface portion **10a** in the width direction H. By these two circumferential direction main grooves **11**, the tread surface portion **10a** is partitioned into a center land portion section **14** that is positioned on the equatorial portion of the tire CL, an inner side shoulder land portion section **15** that is positioned to an inner side of the vehicle X of the equatorial portion of the tire CL, and an outer side shoulder land portion section **16** that is positioned to an outer side of the vehicle Y of the equatorial portion of the tire CL.

In the inner side shoulder land portion section **15**, a plurality of inner side lateral grooves **12** that extend in the width direction of the tire H are formed with a mutual interval in the tire circumference direction R.

Each inner side lateral groove **12** extends along the width direction of the tire H, straddling the end portion in the width direction of the tire H at the inner side of the vehicle X of the tread surface portion **10a** so that an inward end **12a** in the width direction of the tire H is positioned further to the inner side of the vehicle X than the circumferential direction main groove **11** that is positioned on the inner side of the vehicle X among the two circumferential direction main grooves **11**, and an outward end in the width direction of the tire H is positioned on the side portion of the inner side of the vehicle X among both side portions of the tread portion **10b**.

Also, on the outer side shoulder land portion section **16** are formed a plurality of first outer side lateral grooves **13a**, second outer side lateral grooves **13b**, and third outer side lateral grooves **13c**.

A plurality of the first outer side lateral grooves **13a** are formed with a mutual interval in the tire circumference direction R on the inner side of the vehicle X end portion of the outer side shoulder land portion section **16**, and are in communication with the circumferential direction main groove **11** that is positioned on the outer side of the vehicle Y among the two circumferential direction main grooves **11**. Also, the second outer side lateral grooves **13b** and the third outer side lateral grooves **13c** are formed with a mutual interval in the tire circumference direction R on the end portion of the outer side shoulder land portion section **16** on the outer side of the vehicle Y. Among these, the second outer side lateral grooves **13b** are disposed further to the inner side of the vehicle X in the tread surface portion **10a** than the end portion on the outer side of the vehicle Y. Also, the third outer side lateral grooves **13c** straddle the end portion on the outer side of the vehicle Y

5

in the tread surface portion **10a** and reach until the side portion on the outer side of the vehicle Y among both side portions of the tread portion **10b**.

In the present embodiment, the outer side shoulder land portion section **16** is constituted by a first land portion **17** and a second land portion **18** being alternately and consecutively arranged along the tire circumference direction R.

The first land portion **17** is provided with a first top surface portion **17a** that is positioned on the inner side of the width direction of the tire H and a first inclined surface portion **17b** whose recess amount inward in the radial direction of the tire gradually increases heading from the first top surface portion **17a** toward the outer side in the width direction of the tire H. Note that the first top surface portion **17a** constitutes a portion of a ground contact area of the tire that makes ground contact when this pneumatic tire **10** is in a state of rest on a flat road surface under regular conditions. Also, the first top surface portion **17a** is arranged between the first outer side lateral grooves **13a** that are adjacent in the tire circumference direction R.

The second land portion **18** is provided with a second top surface portion **18a** that is positioned on the outer side of the width direction of the tire H and a second inclined surface portion **18b** whose recess amount inward in the radial direction of the tire gradually increases heading from the second top surface portion **18a** toward the inner side in the width direction of the tire H. Note that the second top surface portion **18a** constitutes a portion of the ground contact area of the tire. Also, the second top surface portion **18a** is arranged between the second outer side lateral groove **13b** and the third outer side lateral groove **13c** that are adjacent in the tire circumference direction R.

As a result of the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlapping in the tire circumference direction R, the V-shaped circumferential direction main groove **19** is formed that has the first inclined surface portion **17b** and the second inclined surface portion **18b** as portions of side walls.

Here, regular conditions means that the load and the internal pressure are respectively the maximum load (maximum load capacity) of a single wheel of a suitable size indicated in the following specification and the air pressure that corresponds thereto, and that the rim is a standard rim of a suitable size that is indicated in the following specification (or an "Approved Rim," "Recommended Rim").

Note that the flat road surface means an ideal smooth road surface.

The specification is determined by the valid industry specification in the region where the tire is manufactured or used. For example, "Year book" of "The Tire and Rim Association Inc." in the United States, the "Standards Manual" of "The European Tire and Rim Technical Organization" in Europe, and as specified by the "JATMA Year Book" of the "Japan Automobile Tire Manufacturers Association".

Also, in the present embodiment, the V-shape circumferential direction groove **19** is arranged in the tread surface portion **10a** at a position that is separated in the width direction of the tire H from the equatorial portion of the tire CL by $\frac{1}{2}$ of the distance L in the width direction of the tire H between the equatorial portion of the tire CL and the end portion in the width direction of the tire H. In the illustrated embodiment, the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlap in the tire circumference direction R at a position separated in the width direction of the tire H from the equatorial portion of the tire CL by $\frac{1}{2}$ of the distance L.

6

Here, the depths of the respective inward ends **17c** and **18c** in the radial direction of the tire of the first inclined surface portion **17b** and the second inclined surface portion **18b** are mutually equivalent. The first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlap in the circumferential direction of the tire R at a depth position of between 30% and 80% of the depth at the respective inward ends **17c** and **18c** in the radial direction of the tire. Note that in the illustrated embodiment, the depth of each of the first inclined surface portion **17b** and the second inclined surface portion **18b** at the respective inward ends **17c** and **18c** in the radial direction of the tire is the same as the depth of the circumferential direction main groove **11** that is formed in the central portion of the tread surface portion **10a** in the width direction of the tire H.

Moreover, in the present embodiment, the size of the first land portion **17** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the outer side in the width direction of the tire H, and the size of the second land portion **18** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the inner side in the width direction of the tire H. Also, the inward end **17c** in the circumferential direction of the tire R of the first land portion **17** overlaps with the second top surface portion **18a** of the second land portion **18**. Moreover, the inward end **18c** in the circumferential direction of the tire R of the second land portion **18** overlaps with the first top surface portion **17a** of the first land portion **17**.

Note that in the illustrated embodiment, the first land portion **17** inclines toward one direction (upward on the sheet) in the circumferential direction of the tire R in accordance with heading toward the outer side in the width direction of the tire H, and the second land portion **18** inclines toward the opposite direction (downward on the sheet) of the one direction in the circumferential direction of the tire R in accordance with heading toward the inner side in the width direction of the tire H.

Also, in the illustrated embodiment, the inward end **18c** in the radial direction of the tire of the second land portion **18** continues into the bottom of the circumferential direction main groove **11** that is positioned on the outer side of the vehicle Y among the two circumferential direction main grooves **11** via the bottom of the first outer side lateral groove **13a**.

Moreover, the inward end **17c** in the radial direction of the tire of the first land portion **17** continues into the bottom of the second outer side lateral groove **13b** or the bottom of the third outer side lateral groove **13c**.

As described above, according to the pneumatic tire **10** of the present embodiment, since the V-shaped circumferential direction main groove **19** in which the first inclined surface portion **17b** and the second inclined surface portion **18b** serve as portions of side walls is formed in the outer side shoulder land portion section **16**, it becomes possible to absorb a compressive force heading inward in the radial direction of the tire that acts on the first top surface portion **17a** and the second top surface portion **18a** by the first and second inclined surface portions **17b** and **18b**.

Accordingly, during travel on a dry road surface, even if a large compressive force heading inward in the radial direction of the tire acts on the first top surface portion **17a** and the second top surface portion **18a**, it is possible to suppress the occurrence of buckling, and it is possible to prevent a decline in steering stability.

Also, since portions of the side walls that the V-shaped circumferential direction main groove **19** include the first and

second inclined surface portions **17b** and **18b**, by causing water between the wet road surface and the first and second top surface portions **17a** and **18a** to pass over these first and second inclined surface portions **17b** and **18b**, it is possible to make it smoothly flow into this circumferential direction main groove **19** without resistance, and it is possible to improve the drainage performance by preventing the water in the V-shaped circumferential direction main groove **19** from entering a turbulent state when flowing in.

Furthermore, in the present embodiment, since the V-shaped circumferential direction main groove **19** is formed in the tread surface portion **10a** at a position that is separated in the width direction of the tire H from the equatorial portion of the tire CL by $\frac{1}{2}$ of the distance L where buckling most easily occurs, it is possible to reliably suppress the occurrence of this buckling.

Also, in the present embodiment, since the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlap in the circumferential direction of the tire R at the depth position of between 30% and 80% of the depth at the respective inward ends **17c** and **18c** in the radial direction of the tire, the aforementioned operation effect comes to be reliably exhibited.

Furthermore, in the present embodiment, the size of the first land portion **17** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the outer side in the width direction of the tire H, and the size of the second land portion **18** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the inner side in the width direction of the tire H. Therefore, it becomes possible to additionally facilitate flowing of water between the wet road surface and the first and second top surface portions **17a** and **18a** into the V-shaped circumferential direction main groove **19**, and in addition to being able to reliably improve drainage performance, it becomes possible to prevent the rigidity of the first top surface portion **17a** and the second top surface portion **18a** that constitute a portion of the ground contact area of the tire from decreasing by forming the V-shaped circumferential direction main groove **19**, and it is possible to prevent a reduction in steering stability and quietness when traveling over a dry road surface.

Also, in the present embodiment, since the inward end **17c** in the radial direction of the tire of the first inclined surface portion **17b** overlaps in the circumferential direction of the tire R with the second top surface portion **18a** of the second land portion **18**, and the inward end **18c** in the radial direction of the tire of the second inclined surface portion **18b** overlaps in the circumferential direction of the tire R with the first top surface portion **17a** of the first land portion **17**, the side walls of the V-shaped circumferential direction main groove **19** have not only the first inclined surface portion **17b** and the second inclined surface portion **18b** but also the respective sides of the first top surface portion **17a** of the first land portion **17** and the second top surface portion **18a** of the second land portion **18**, so it becomes possible to facilitate ensuring sufficient internal volume of this circumferential direction main groove **19**, and it is possible to reliably increase the drainage performance.

Note that the technical scope of the present invention is not limited to the aforementioned embodiment, and it is possible to make various modifications within a scope that does not depart from the spirit of the present invention.

For example, the aforementioned embodiment shows a constitution of the V-shaped circumferential direction main groove **19** consisting of the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually over-

lapping in the tire circumference direction R at a position separated in the width direction of the tire H from the equatorial portion of the tire CL by $\frac{1}{2}$ of the distance L in the width direction of the tire H between the equatorial portion of the tire CL and the end portion in the width direction of the tire H. However, the position in the width direction of the tire H of overlapping in this way is not limited to this embodiment.

Also, the position in the width direction of the tire H of forming the V-shaped circumferential direction main groove **19** in the tread surface portion **10a** is not limited to this embodiment and may be formed at any position provided it is separated from the equatorial portion of the tire CL in the tread surface portion **10a**.

Moreover, in this embodiment, this circumferential direction main groove **19** was formed only in the outer side shoulder land portion section **16**, but it may also be formed in the inner side shoulder land portion section **15**, and may also be formed only in the inner side shoulder land portion section **15** without being formed in the outer side shoulder land portion section **16**.

Also, the depth position at which the first inclined surface portion **17b** and the second inclined surface portion **18b** mutually overlap in the tire circumference direction R is not limited to the present embodiment.

Furthermore, in the present embodiment, the depths at the respective inward ends **17c** and **18c** in the radial direction of the tire of the first inclined surface portion **17b** and the second inclined surface portion **18b** were made mutually equivalent, but may be made to differ.

Also, in the present embodiment, the size of the first land portion **17** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the outer side in the width direction of the tire H, and the size of the second land portion **18** in the circumferential direction of the tire R gradually becomes smaller in accordance with heading toward the inner side in the width direction of the tire H, but instead of this, for example, each size of the first land portion **17** and the second land portion **18** in the circumferential direction of the tire R may be made equal throughout the width direction of the tire H.

Furthermore, the first inclined surface portion **17b** and the second inclined surface portion **18b** are made to incline in a linear shape heading inward in the radial direction of the tire, but may also be made to incline in a curved shape.

Still further, instead of the aforementioned embodiment, the first land portion **17** and the second land portion **18** may be extended parallel with the width direction of the tire H without sloping in the circumferential direction of the tire R.

Next, verification testing of the operational effects described above was carried out.

First, the pneumatic tires supplied to this test shall be described. As the pneumatic tire **10** of an example of the present invention, the pneumatic tire shown in FIG. 1 and FIG. 2 was used, and as the pneumatic tire of the conventional example, a pneumatic tire in which a circumferential direction groove **11** of the same shape and same size as the circumferential direction main groove **11** that is formed in the central portion of the tread surface portion **10a** in the width direction of the tire H is formed instead of the V-shaped circumferential direction main groove **19** in the pneumatic tire **10** shown in FIG. 1 and FIG. 2 was used.

Also, the size of each pneumatic tire was 225/45R17, and each pneumatic tire was attached to a rim of size 7J-17, inflated to the vehicle specified pressure, and mounted on a vehicle.

Then, the steering stability was evaluated when driving on a dry road surface of an ordinary road and a circuit with the

driver's weight and a 600 N vertical load mounted on this vehicle. This evaluation was carried out based on the feeling of the driver, and the evaluation was made with an index having the conventional pneumatic tire set to 100.

Moreover, this vehicle was driven on a set road surface having a water depth of 10 mm, and the drainage performance was evaluated based on the speed at which the hydroplaning phenomenon occurred. This evaluation was made with an index having the conventional pneumatic tire set to 100.

The results are shown in Table 1. Note that in this table, the higher the number in each evaluation item, the better the performance.

TABLE 1

		Example	Conventional Example
Steering Stability	Ordinary Road	102	100
	Circuit	108	100
Drainage Performance		103	100

According to this result, it was confirmed that with the pneumatic tire of the example, it becomes possible to prevent a decline in steering stability and it is possible to improve the drainage performance. In particular, with the pneumatic tire of the example, compared to the pneumatic tire of the conventional example, it was confirmed that it is possible to greatly improve the steering stability on a dry road surface of a circuit where a high load acts on the pneumatic tire during vehicle running.

INDUSTRIAL APPLICABILITY

According to the present invention, it is possible to provide a pneumatic tire in which it becomes possible to prevent a decline in steering stability and which is capable of improving drainage performance.

The invention claimed is:

1. A pneumatic tire comprising:

a plurality of circumferential direction main grooves extending in a circumferential direction of the tire and formed in a tread surface portion of the tire; and

a plurality of land portion sections extending in the circumferential direction of the tire and formed in the tread surface portion,

wherein at least one of the land portion sections that are arranged at positions that are separated from an equatorial portion of the tire among the plurality of land portion sections is constituted of a first land portion and a second land portion that are alternately and consecutively arranged in the circumferential direction of the tire,

a first top surface portion that is positioned on the inner side of a width direction of the tire and a first inclined surface portion whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the first top surface portion toward the outer side in the width direction of the tire are provided in the first land portion, a second top surface portion that is positioned on the outer side of the width direction of the tire and a second inclined surface portion whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the second top surface portion toward the inner side in the width direction of the tire are provided in the second land portion, and by the first inclined surface portion and the second inclined surface portion mutually overlapping in the circumferential direction of the tire, one of the plu-

rality of circumferential direction main grooves is formed in this land portion section as a V-shaped groove that has the first inclined surface portion and the second inclined surface portion as portions of side walls,

the V-shaped groove is disposed only further to an outer side of a vehicle on which the tire is mounted, than the equatorial portion,

a second one of the plurality of circumferential direction main grooves includes a bottom surface continuously extending in the circumferential direction of the tire,

the second one of the plurality of circumferential direction main grooves is entirely disposed further to an inner side of the vehicle than the first land portion, and

wherein the second one of the plurality of circumferential direction main grooves is disposed to be adjacent to the first land portion, and has a constant depth on the entire circumference of the tire,

a first groove is formed between two first land portions adjacent to each other in the circumferential direction, and

an inward end of the second inclined surface portion on the inner side in the width direction of the tire connects to a bottom of the second one of the plurality of circumferential direction main grooves via a bottom of the first groove

no circumferential direction main groove formed by overlapping land portions in the circumferential direction is disposed at the equatorial portion and further to the inner side of the vehicle, than the equatorial portion.

2. The pneumatic tire according to claim 1,

wherein the V-shaped groove is arranged in the tread surface portion at a position that is separated in the width direction of the tire from the equatorial portion of the tire by $\frac{1}{2}$ of the distance in the width direction of the tire between the equatorial portion of the tire and the end portion in the width direction of the tire.

3. The pneumatic tire according to claim 1,

wherein the depths at the respective inward ends in the radial direction of the tire of the first inclined surface portion and of the second inclined surface portion are mutually equivalent, and

the first inclined surface portion and the second inclined surface portion mutually overlap in the circumferential direction of the tire at a depth position of a percentage between 30% and 80% of the depth at their respective inward ends in the radial direction of the tire.

4. The pneumatic tire according to claim 1,

wherein the size of the first land portion in the circumferential direction of the tire gradually decreases in accordance with heading toward the outer side in the width direction of the tire; and

the size of the second land portion in the circumferential direction of the tire gradually decreases in accordance with heading toward the inner side in the width direction of the tire.

5. The pneumatic tire according to claim 1,

wherein an inner side shoulder land portion section among the plurality of land portion sections is composed of a third land portion continuously extending in the circumferential direction, the third land portion reaching an edge of the tread surface portion on an inner side of the vehicle,

the third land portion is provided with lateral grooves extending in a direction crossing to the circumferential direction, and

ends of the lateral grooves on an outer side of the vehicle are positioned further to an inner side of the vehicle, than an edge of the third land portion on an outer side of the vehicle.

6. The pneumatic tire according to claim 5, 5
 wherein second inclined surface portions whose recess amount inward in the radial direction of the tire gradually increases in accordance with heading from the second top surface portion toward the inner side in the width direction of the tire are provided in the second land 10
 portion, and by the first inclined surface portion and each second inclined surface portion mutually overlapping in the circumferential direction of the tire, the V-shaped groove is formed,
 the second land portion is provided with a second groove 15
 extending in a direction crossing to the circumferential direction, and an end of the second groove on an outer side of the vehicle is positioned further to an inner side of the vehicle, than an edge of the second top surface portion on an outer side of the vehicle, 20
 a third groove is formed between two second land portions adjacent to each other in the circumferential direction, and the third groove reaches an edge of the tread surface portion on an outer side of the vehicle,
 the second groove is disposed between the second inclined 25
 surface portions adjacent to each other in the circumferential direction, and
 the first inclined surface portion is disposed between, in the circumferential direction, the second inclined surface portions between which the second groove is disposed. 30

* * * * *